Centre Number	Candidate Number

Candidate Name _____

CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Advanced Level

BIOLOGY 9700/6

PAPER 6 Options

MAY/JUNE SESSION 2002

1 hour

Additional materials:
Answer paper

TIME 1 hour

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page and on all separate answer paper used.

Answer the questions set on **one** of the options.

Within your chosen option, Questions 1 and 2 are to be answered in the spaces provided on the question paper. Question 3 is to be answered on the separate answer paper provided.

The answer to Question 3 should be illustrated by large, clearly labelled diagrams wherever appropriate.

At the end of the examination,

1. fasten all separate answer paper securely to the question paper;
2. enter the number of the option you have answered in the grid below.

INFORMATION FOR CANDIDATES

The intended number of marks is given in brackets [ ] at the end of each question or part question.

The options are:

1 – Biodiversity (page 2)

2 – Biotechnology (page 8)

3 – Growth, Development and Reproduction (page 12)

4 – Applications of Genetics (page 19)

You are reminded of the need for good English and clear presentation in your answers.

OPTION ANSWERED	
FOR EXAMINER'S USE	
1	
2	
3(a)	
3(b)	
TOTAL	

This question paper consists of 24 printed pages.

© CIE 2002

UNIVERSITY of CAMBRIDGE
Local Examinations Syndicate

[Turn over

For Examiner's Use

OPTION 1 – BIODIVERSITY

1 **(a)** Fig. 1.1 shows three animals, each belonging to a different phylum.

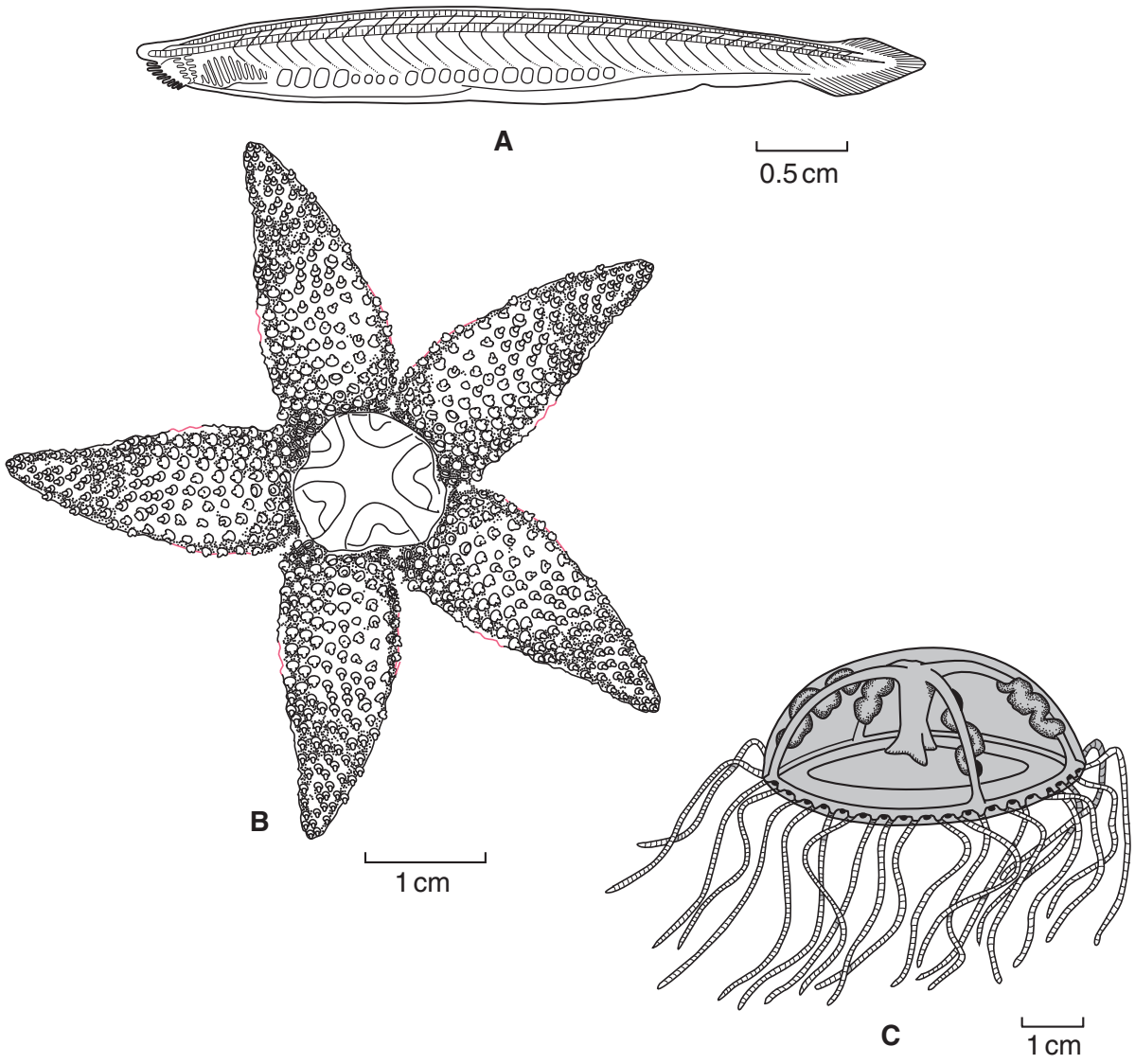


Fig. 1.1

Name the phylum to which each animal belongs and state **one** diagnostic feature, visible on the diagram, that confirms your classification.

A *phylum* .....

diagnostic feature .....

B *phylum* .....

diagnostic feature .....

C *phylum* .....

diagnostic feature .....[3]

(b) Fig. 1.2 shows a transverse section through an earthworm, *Lumbricus terrestris*, which is an annelid.

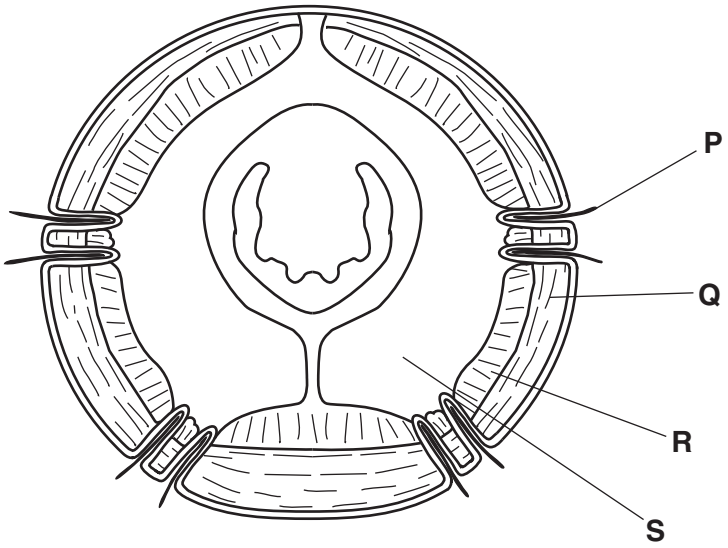


Fig. 1.2

(i) State three ways in which the body plan of an annelid differs from that of a cnidarian.

1. .....

.....

2. .....

.....

3. .....

.....[3]

(ii) Describe how structures **P**, **Q**, **R** and **S** are involved in the locomotion of an earthworm.

.....

.....

.....

.....

.....

.....[4]

(c) Some earthworms deposit their egested material on the surface of the soil as worm casts. Table 1.1 shows the calcium, magnesium and carbon content of worm casts in an arable field and of the top 15 cm of the soil in the same field.

Table 1.1

element	worm casts	top 15 cm of soil
calcium / ppm	2790	1900
magnesium / ppm	492	162
carbon / %	5.17	3.35

(i) Describe how earthworms feed.

.....

.....

.....[2]

(ii) With reference to Table 1.1, suggest explanations for the differences in composition between the worm casts and the soil.

.....

.....

.....

.....

.....[3]

[Total : 15]

2 In many tropical rainforests, deforestation is breaking up large, continuous areas of forest into many small fragments, separated by non-forested regions. There is concern about the effects that this may have on species diversity within the forests.

(a) Explain why deforestation is occurring.

.....

.....

.....

.....[3]

(b) Investigations have been carried out into the effects of fragmentation of the forest on the rainforest trees. In one such investigation, the percentage of dead and dying trees of different sizes was estimated in the interior of a forested area and also at the edges of forest fragments. The percentage increase of the dead and dying trees at the edge, compared with the interior, was then calculated for each size range. The results are shown in Fig. 2.1.

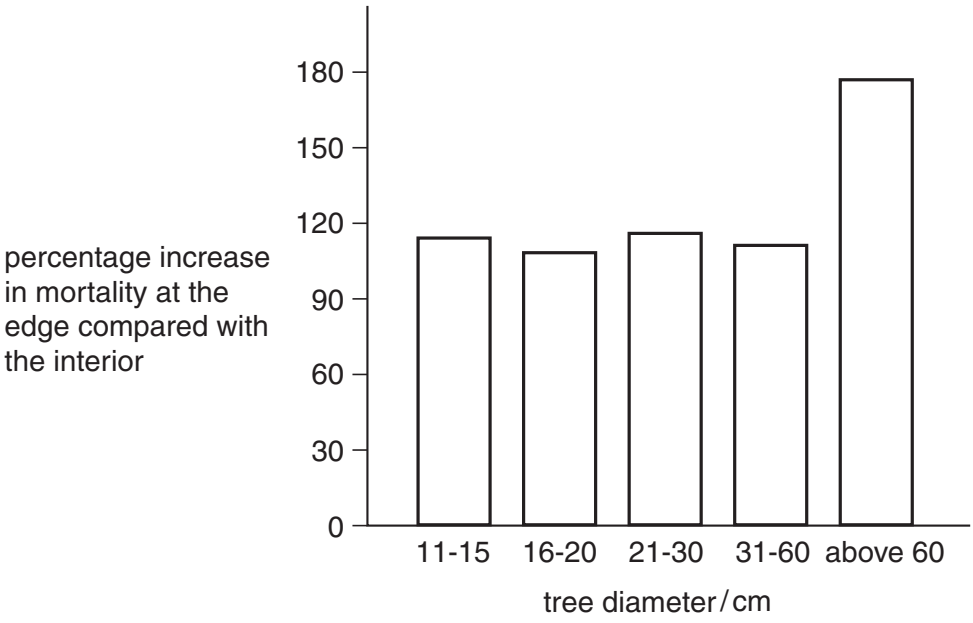


Fig. 2.1

With reference to Fig. 2.1,

(i) state two conclusions that can be made from these data;

1. .....

.....

2. .....

.....[2]

(ii) suggest two explanations for these results.

1. .....

.....

.....

2. .....

.....

.....[3]

(c) In a separate investigation, the density of new tree seedlings that were growing in a rainforest was measured. This was carried out in continuous forest and in fragments of approximately 100 hectares, 10 hectares and 1 hectare. The density of tree seedlings was also measured in three positions (interior, edge and corner) of one of the 100 hectare fragments and one of the 10 hectare fragments. The results are shown in Fig. 2.2.

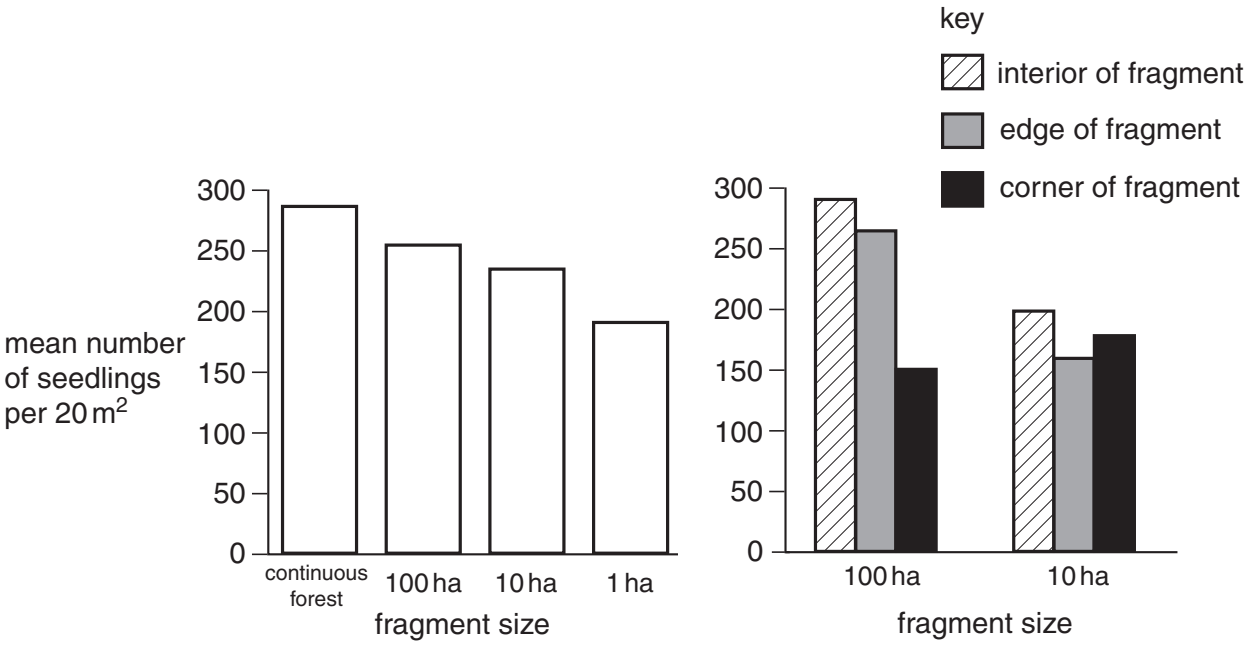


Fig. 2.2

(i) State the conclusions that can be made from the results shown in Fig. 2.2.

.....

.....

.....[2]

(ii) Explain, with reference to Fig. 2.1, the results shown in Fig. 2.2.

.....

.....

.....

.....

.....[3]

(d) Describe how the results shown in Figs 2.1 and 2.2 could be used when planning the measures that should be taken to conserve biodiversity in tropical rainforests.

.....

.....

.....

.....[2]

[Total : 15]

3 Either

(a) (i) Compare the structure of *Escherichia coli* with that of *Paramecium.* [8]

Discuss the range of uses in biotechnology of

(ii) bacteria, [6]

(iii) fungi. [6]

[Total : 20]

Or

(b) (i) Describe how you could distinguish a bryophyte from a filicinophyte. [8]

Discuss the extent to which the following groups are adapted to life on land.

(ii) bryophytes [6]

(iii) coniferophytes [6]

[Total : 20]

For Examiner's Use

OPTION 2 – BIOTECHNOLOGY

1 **(a)** Describe the main processes involved in the large-scale fermentation of starch to produce ethanol.

.....

.....

.....

.....

.....[4]

(b) State three ecological reasons why biofuels, such as gasohol, should be developed.

1. .....

2. .....

3. .....[3]

(c) A review of gasohol as an alternative motor fuel to petrol was made in Illinois using the scale below.

–3	–2	–1	0	+1	+2	+3
worse than petrol			same as petrol		better than petrol	

The results of the review are shown in Table 1.1.

Table 1.1

feature	score
engine performance	+2
exhaust emissions	+2
refuelling	0
fuel economy	0
maintenance costs	–1
fuel tank weight	–1
drivability	–1
solvent action on paintwork	–2
cold weather starts	–3

With reference to Table 1.1, evaluate the advantages and disadvantages of using gasohol as a motor fuel.

.....

.....

.....

.....

.....[4]

(d) Gasohol is only used and produced in certain parts of the world.

Suggest two reasons why this is so.

1. .....

2. .....[2]

(e) Biogas digesters are potentially useful in non-industrial countries.

State two advantages of producing methane by this method.

1. .....

2. .....[2]

[Total : 15]

2 **(a)** Glucose biosensors can be made in many different ways by using the enzyme glucose oxidase.

Suggest two methods that could be used to measure the glucose concentration.

1. .....

2. .....[2]

(b) Diabetes has long been associated with diet. Fig. 2.1 shows the relationship between the consumption of refined sugar and the number of people with diabetes in Denmark.

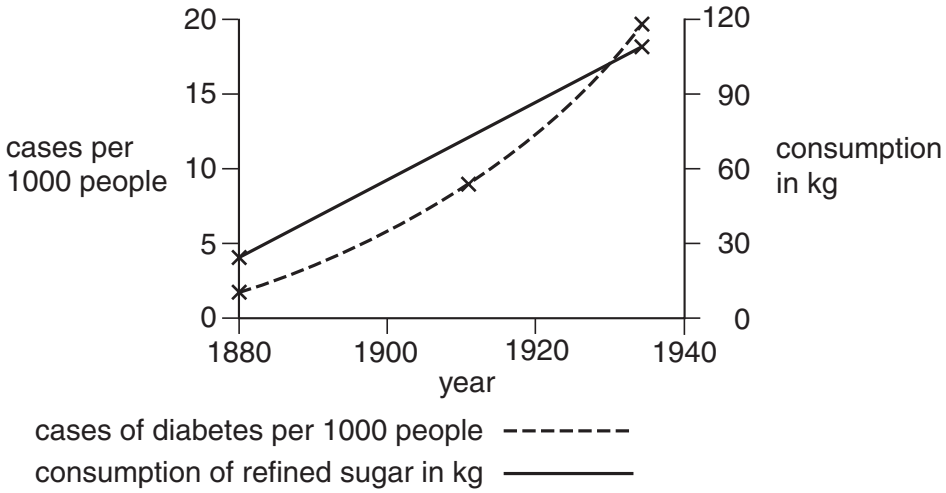


Fig. 2.1

(i) State two symptoms that a person might show if their pancreas was **not** functioning correctly.

1. .....

2. .....[2]

(ii) State the conclusions that can be made from the data shown in Fig. 2.1.

.....

.....

.....

.....[3]

(iii) Suggest how the conclusions made from the data shown in Fig. 2.1 might **not** be correct.

.....

.....

.....[2]

(c) The first pancreatic transplant took place in 1965. Others followed but the results were disappointing and the operations were stopped.

State two benefits to a diabetic person of having a pancreas transplant.

1. .....

2. .....[2]

(d) Bacteria have been genetically engineered to produce insulin and are now used in the large-scale production of insulin.

Discuss the advantages of producing insulin in this way rather than extracting it from cows or pigs.

.....

.....

.....

.....

.....[4]

[Total : 15]

3 Either

(a) (i) Describe the production of mycoprotein. [8]

Discuss the use of genetic engineering in improving the quality and yield of

(ii) crop plants, [6]

(iii) animals. [6]

[Total : 20]

Or

(b) (i) Evaluate the relevance of agricultural biotechnology to a nation with limited areas of land suitable for agriculture. [6]

Discuss the role of biotechnology in

(ii) making yoghurt, [7]

(iii) tenderising meat. [7]

[Total : 20]

OPTION 3 – GROWTH, DEVELOPMENT AND REPRODUCTION

1 Fig. 1.1 shows the changes in the relative proportions of different parts of the body of a human male during growth from a fetus to an adult.

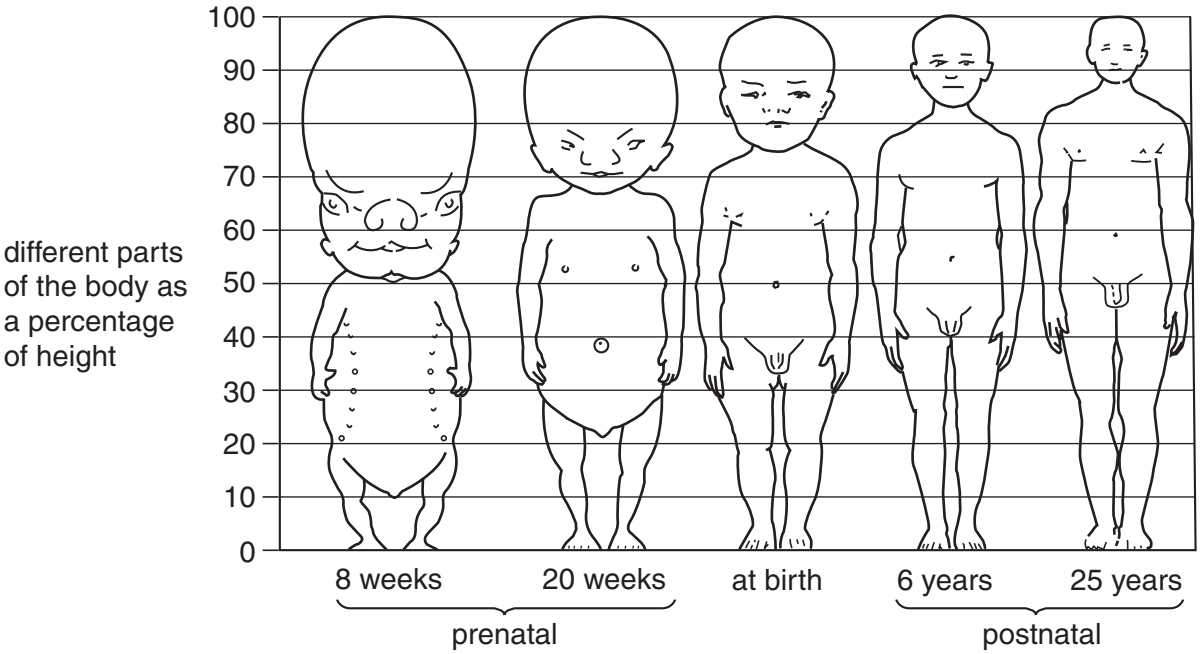


Fig. 1.1

(a) State the term that is used to describe the growth of different parts of the body at different rates.

.....[1]

(b) With reference to Fig. 1.1,

(i) compare the relative sizes of the head of an eight week fetus with 1. a baby at birth and 2. an adult of twenty-five years;

1. .....

.....

2. .....

.....[2]

(ii) suggest three reasons that might account for the differing relative sizes you have described in **(i)**.

1. .....

.....

2. .....

.....

3. .....

.....[3]

(c) Fig. 1.2 shows the percentage of babies with different birth masses and the percentage mortality in the first month after birth of babies with different birth masses.

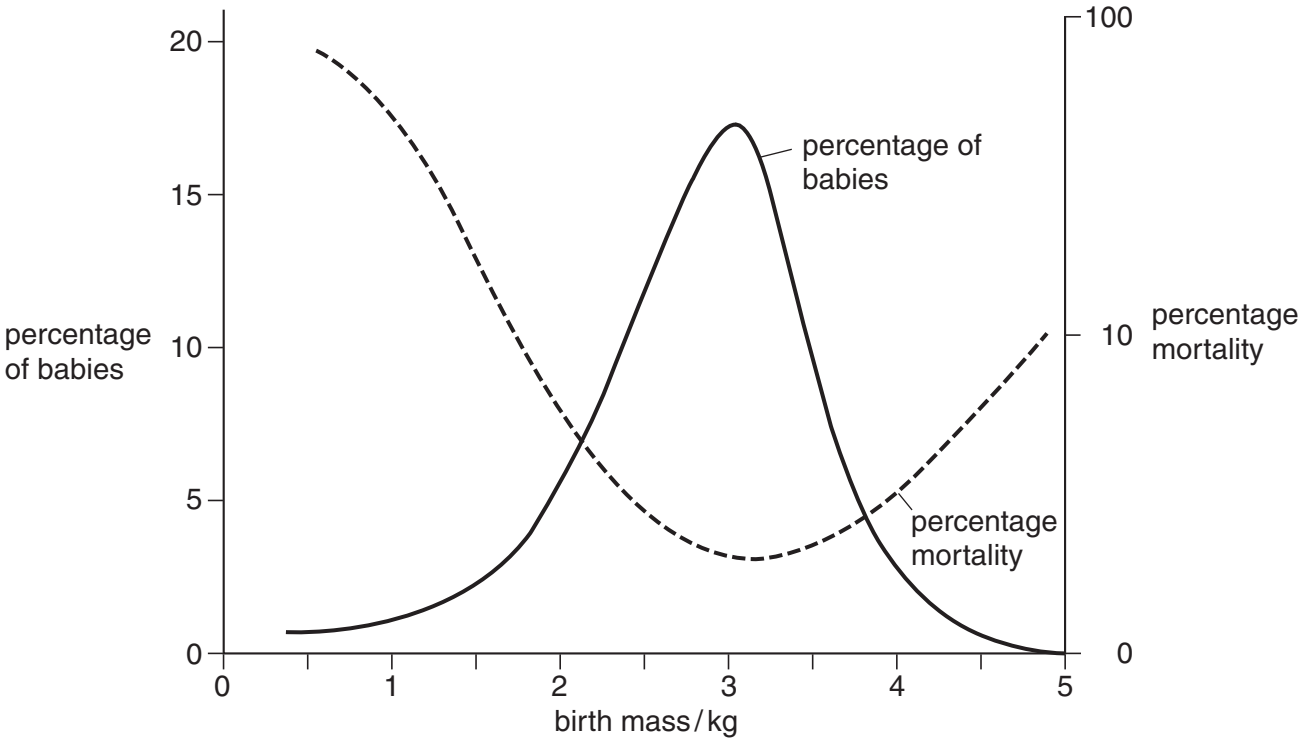


Fig. 1.2

With reference to Fig. 1.2,

(i) describe the relationship between birth mass and mortality;

.....

.....

.....

.....

.....[3]

(ii) explain the evolutionary consequences of the relationship you described in **(i)**.

.....

.....

.....

.....[2]

Fig. 1.3 shows a comparison of the percentage of babies with different birth masses born to mothers who were smokers and to mothers who were non-smokers.

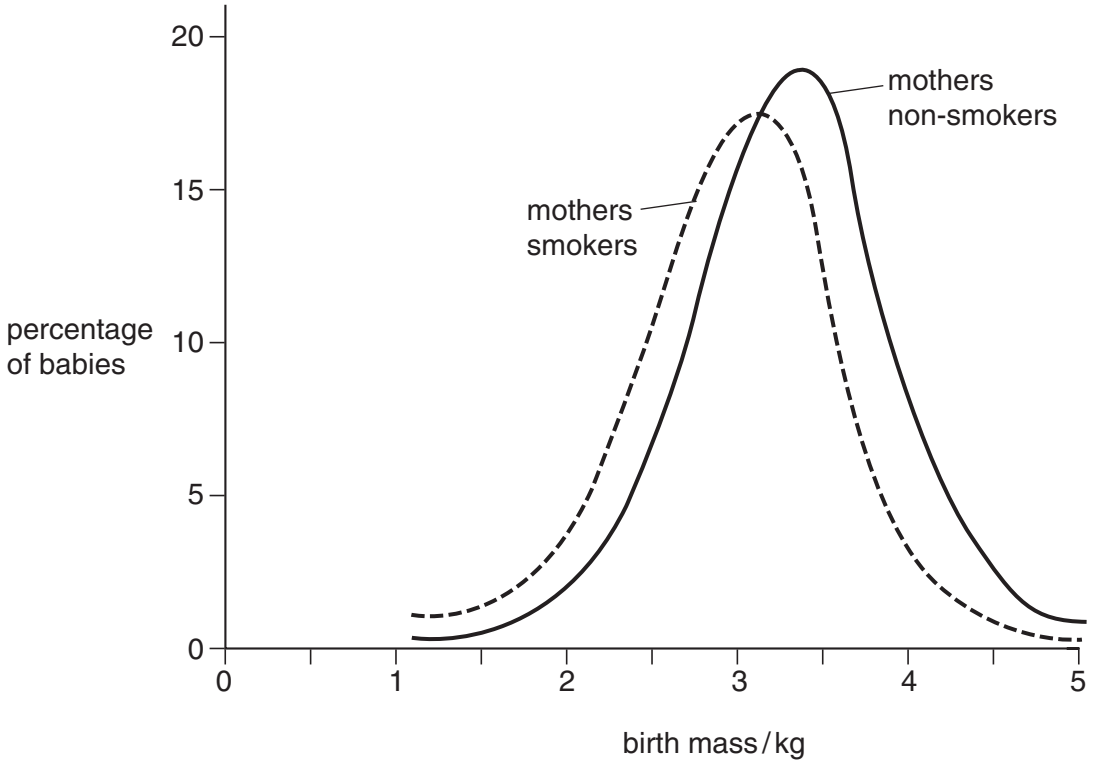


Fig. 1.3

(d) With reference to Fig. 1.3, describe the effect of smoking by the mothers on the birth masses of their babies.

.....

.....

.....

.....[2]

(e) Explain two **other** harmful effects of smoking by a mother on her fetus.

1. .....

.....

2. .....

.....[2]

[Total : 15]

2 During the growth of a seed, nutrients are transferred from the parent plant to the seed. Fig. 2.1 shows changes in the dry mass of some substances in almond seeds during seed ripening.

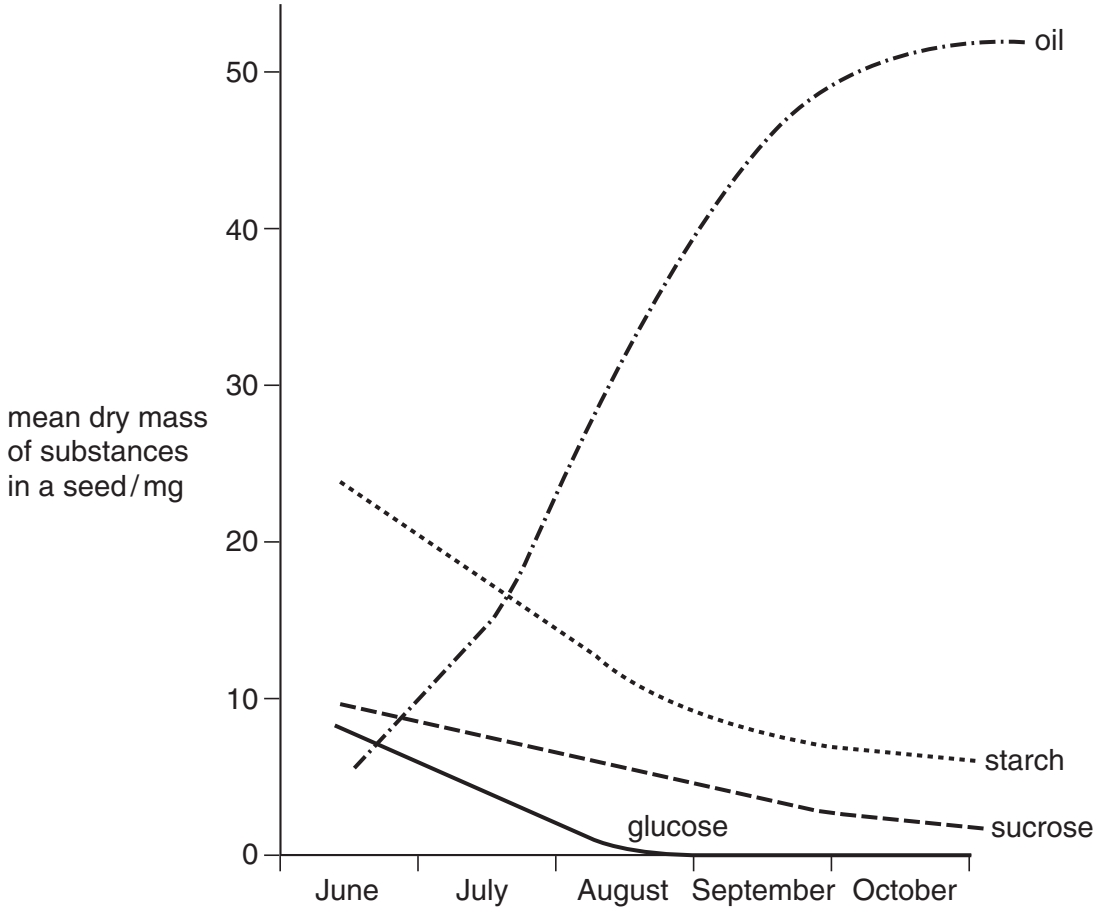


Fig. 2.1

(a) With reference to Fig. 2.1, explain the changes in the mass of carbohydrates and oil.

carbohydrates .....

.....

.....

.....

.....

oil .....

.....

.....[4]

(b) Explain the benefits to a plant of storing oil, rather than starch, as a reserve.

.....

.....

.....[2]

(c) Describe how oil would be utilised by a germinating seed.

.....

.....

.....

.....[3]

(d) Describe, with reasons, the changes in the dry mass of a seed from the onset of germination until the seedling is living independently of food reserves.

.....

.....

.....

.....

.....[4]

(e) Seed germination is affected by certain plant growth regulators.

Describe two actions of gibberellins during seed germination.

1. .....

.....

2. .....

.....[2]

[Total : 15]

3 Either

(a) (i) Describe **two** different asexual methods used to propagate commercially important plants. [6]

(ii) Discuss the advantages and disadvantages to crop growers of using asexual propagation. [7]

(iii) Explain how sexual reproduction in flowering plants can lead to new genetic combinations. [7]

[Total : 20]

Or

(b) (i) Describe the role of the thyroid gland and the functions of thyroxine in human growth and development. [8]

(ii) Explain how thyroxine secretion is controlled within the body. [6]

(iii) Outline the role of hormones in hormone replacement therapy (HRT). [6]

[Total : 20]

OPTION 4 – APPLICATIONS OF GENETICS

1 The banding pattern of the shells of the land snail, *Cepaea nemoralis*, is controlled by two unlinked genes. Shells may be unbanded, midbanded or five-banded, as shown in Fig. 1.1.



Fig. 1.1

The dominant allele, **B**, of one gene gives unbanded shells, whilst the recessive allele, **b**, gives banded shells. The dominant allele, **M**, of the second gene results in midbanded shells whilst the recessive allele, **m**, gives five-banded shells.

(a) (i) Name the type of interaction shown by these two genes.

.....[2]

(ii) Explain how the allele **B** affects the gene **M/m**.

.....

.....

.....

.....[3]

(b) A snail with an unbanded shell with the genotype **BBMM** was mated with a snail with a five-banded shell and the F_1 offspring interbred to give an F_2 generation.

Draw a genetic diagram of this cross to show the genotype of the five-banded parent, the gametes and the genotypes and phenotypes of the F_1 and F_2 generations. State the ratio of phenotypes in the F_2 generation.

ratio of F_2 phenotypes .....[8]

(c) The **B/b** gene is very tightly linked to a gene controlling the colour of the snail shell. The allele giving a pink shell is dominant to that giving yellow. A homozygous, unbanded, pink-shelled snail was mated with a homozygous, banded, yellow-shelled snail and the F_1 offspring test crossed.

(i) State what is meant by the term *linkage*.

.....

.....[1]

(ii) State the ratio of phenotypes expected in the offspring of the test cross described above.

.....

.....[1]

[Total : 15]

2 **(a)** Explain briefly how DNA is prepared for electrophoresis in genetic fingerprinting and genetic screening.

.....

.....

.....

.....

.....

.....[4]

Many cases of the genetic disease ß-thalassaemia result from a large deletion in the gene for ß globin.

(b) Explain how electrophoresis allows an allele with a large deletion to be distinguished from the normal allele.

.....

.....

.....[2]

[Turn over

One therapy for ß-thalassaemia is to transplant bone marrow cells from a genetically compatible donor into the patient.

(c) Explain briefly the role of the major histocompatibility (HLA) system in genetic compatibility.

.....

.....

.....

.....

.....[4]

A potential gene therapy for ß-thalassaemia involves adding the normal, dominant allele for ß globin to the patient's bone marrow cells.

(d) Explain why it is theoretically easier to perform gene therapy when a mutant allele is recessive than when it is dominant.

.....

.....

.....

.....[3]

(e) Such gene therapy has been tested in mice. Bone marrow cells carrying the normal allele for human ß globin were implanted both in normal mice and in mice heterozygous for the deletion causing ß-thalassaemia. Twenty-four weeks later, the percentage of haemoglobin containing two human ß globin chains was measured in both types of mouse. The results are shown in Table 2.1.

Table 2.1

type of mouse	percentage of mouse haemoglobin with two human ß globin chains
normal	13
heterozygous for the deletion causing ß-thalassaemia	24

With reference to Table 2.1, suggest why the human gene is expressed less in normal mice.

.....

.....

.....[2]

[Total : 15]

3 Either

(a) (i) Explain the need to maintain rare breeds of animals. [6]

(ii) Describe the process of selective breeding in a **named** animal. [8]

(iii) Describe the harmful effects of inbreeding animals. [6]

[Total : 20]

Or

(b) (i) Explain briefly what is meant by the terms *gene mutation* and *chromosome mutation*. [6]

(ii) Compare the mutations responsible for cystic fibrosis (CF) and Huntington's disease (HD) and explain the effect on the inheritance of each disease. [8]

(iii) Explain why mutations for antibiotic resistance spread so rapidly among bacteria. [6]

[Total : 20]

Copyright Acknowledgements:

Option 1. From *Invertebrate Zoology, 6th Edition*, E. Ruppert, R. Barnes. © 1994. Reprinted with permission of Brooks/Cole, an imprint of the Wadsworth Group, a division of Thomson Learning. Fax 800 730-2215.

Option 3. Stanley Ulijaszek. Cambridge Encyclopedia of Human Growth and Development. 1998. Cambridge University Press.

Option 4. M Carter. Genetics and Evolution. Reproduced by Hodder and Stoughton Educational Limited.

Cambridge International Examinations has made every effort to trace copyright holders, but if we have inadvertently overlooked any we will be pleased to make the necessary arrangements at the first opportunity.